A.2 Riparian Brush Rabbit (*Sylvilagus bachmani riparius*)

A.2.1 Legal Status

The riparian brush rabbit (*Sylvilagus bachmani riparius*) is listed as endangered under the state and federal endangered species acts. It was initially listed as endangered by the state of California on May 29, 1994. The U.S. Fish and Wildlife Service (USFWS) proposed the species for endangered species protection on November 21, 1997, and reopened the proposal for further public input on April 13, 1998 to include survey data from the 1998 winter floods in its final determination on whether or not to list the species. The USFWS issued its final determination to list the species as endangered on February 23, 2000 (65 FR 8881).

Critical habitat has not been designated for this species because the USFWS believed it would not provide any additional benefit beyond that provided through listed as endangered since the species was only known to occur within Caswell State Park (65 FR 8881). Subsequent rulings allow critical habitat to be designated post-listing following further analysis.

A.2.2 Species Distribution and Status

Range and Status

One of eight species of brush rabbit, the riparian brush rabbit occupies a range that is disjunct from other brush rabbits, near sea level on the floor of the San Joaquin Valley (USFWS 1998). Documented occurrences are shown in Figure A.2.1. Its historical distribution may have extended along portions of the San Joaquin River and its tributaries on the valley floor from at least Stanislaus County to the Delta (Orr 1935 in USFWS 1998). Populations were known to have occurred in riparian forests along the San Joaquin and Stanislaus Rivers and some tributaries to the San Joaquin River on the valley floor (USFWS 1998). One population estimate within this historical range was about 110,000 individuals (USFWS 1998).

The dramatic decline of the riparian brush rabbit began in the 1940s with the building of dams, constructed for irrigation and flood control, on the major rivers of the Central Valley. Protection from flooding resulted in conversion of floodplains to croplands and the consequent reduction and fragmentation of remaining riparian communities. By the mid-1980s, the riparian forest within the species' former range had been reduced to a few small and widely scattered fragments totaling about 5,189 acres (ac) (USFWS 1998). Within this area, remaining populations of riparian brush rabbits occur in only two areas of San Joaquin County. The first is a patch of approximately 258 ac in Caswell Memorial State Park on the Stanislaus River (the largest remaining fragment of suitable riparian forest). The second is an estimated 270 ac in several small, isolated, semi-isolated patches along Paradise Cut and Tom Paine Slough and channels of the San Joaquin River in the South Delta (Williams et al. 2002a).

The most serious ongoing problem has been the lack of suitable habitat above the level of regular floods where the animals could find food and cover for protection from weather and predators. Flooding during the 1970s resulted in additional population declines with estimates of the extent population ranging from just 15 to 20 individuals (DFG 2000). In January 1993, Caswell State Park was thought to support the only extant population, with an estimate of between 213 and 312 individuals. Flooding of the park in 1996 inundated more than 80 percent of the park, which

[A]*Source:*
1. California Department of Fish and Game, CNDDB, 2008.
2. Williams et al., 2002.
3. USFWS, Recovery Plan for Upland Species of the San Joaquin Valley, CA, 1998.

Figure A.2.1. Riparian Brush Rabbit Statewide Range and Recorded Occurrences

contributed to additional population declines. The 1993 census was the last for which a reliable population estimate could be generated for the Caswell State Park population. Surveys conducted in 2002 (Williams et al. 2002a) resulted in the highest number of captures since the 1993 census, but still not sufficient to generate a population estimate.

Access restrictions at the South Delta population prevent sufficient sampling to reliably estimate the population size; however, based on trapping conducted during 1998-99, this population is estimated to include between 25 and 100 individuals (Williams et al. 2002b)

Distribution and Status in the Planning Area

Of the two extant populations of riparian brush rabbit, only the South Delta population (Paradise Cut and Tom Paine Slough) occurs within the BDCP Planning Area. As indicated above, occurrence locations in this area are on private land and watercourses are managed for flood control, not wildlife management.

A.2.3 Habitat Requirements and Special Conditions

Riparian brush rabbits inhabit the brushy understory shrub layer of valley riparian forests. Closely associated with dense shrub vegetation, occupied sites tend to be in riparian settings with an open overstory canopy or savannah-like settings that support patches of low-growing wild rose (*Rosa californica*), wild grape (*Vitis californica*), or blackberry (*Rubus* spp) where the brush rabbits move through the dense brush and thickets by creating tunnels through the vegetation. Generally, riparian forests that support a closed overstory canopy lack sufficient understory shrubs to support riparian brush rabbits (USFWS 1998).

Sites inhabited by riparian brush rabbits usually have a mix of roses, blackberries, marsh baccharis, and grape vines, with high volumes of roses and coyote bushes (*Baccharis* sp.) in comparison to uninhabited sites (USFWS 1998, Williams 1988, Basey 1990). Williams and Basey (1986) also note that brush rabbit sites support significantly more ground litter and surface area of roses and significantly fewer willows in the canopy and understory than sites occupied by desert cottontails. Additionally, they indicate that the presence of more surface litter and lack of willows in the understory signify areas of higher ground that are not flooded regularly or heavily.

Patch size is important and fragmentation of intact riparian forests is a major issue restricting occupancy and overall distribution of the species. Brushy clumps smaller than 400 square yards are rarely occupied.

Flooding is a key issue for this species and is thought to be responsible for major population declines. Riparian brush rabbits are closely tied to brushy cover and will generally not cross large, open areas. They are thus unable to disperse beyond the dense brush making them susceptible to mortality during flood events (USFWS 1998, Williams 1988).

A.2.4 Life History

Description. The riparian brush rabbit is a small brownish cottontail-like rabbit with a white belly, relatively short ears, and a small inconspicuous tail. The hind legs are short and hind feet are slender and not covered with long or dense hair. The white belly and ventral tail hairs are gray near the skin and the ears lack dark tips (Orr 1940, Ingles 1965, Chapman 1974). Adult riparian brush rabbits are about 13 inches long and can be distinguished from other subspecies by their relatively pale color, gray sides, darker back (Orr 1935), restricted range and habitat requirements, and skull characteristics. When looking down at the head from above, the riparian

brush rabbit cheeks protrude outward rather than being straight or curving inward as in other subspecies (Orr 1935, 1940).

Features that distinguish the riparian brush rabbit from the desert cottontail (*S. audubonii*) include size and coloration. The riparian brush rabbit is smaller and darker grayish-brown, though populations of desert cottontails living along Central Valley rivers are about the same color as the riparian brush rabbit (which is lighter colored than many of the other subspecies). The tail of the brush rabbit is small and inconspicuous compared to the desert cottontail, and its ears are uniformly colored. The tail of the desert cottontail shows much white viewed from behind, and the inner (medial) tips of the ears are black. When looked at from above, the cheeks of the brush rabbit protrude whereas those of the desert cottontail are slightly concave (Sandoval et al. 2006)

Activity. Riparian brush rabbits are active throughout the year and are most active during the twilight hours around dawn and dusk. Depending on season, the main activity periods generally last from two to four hours. The period of least activity is from about 1,030 to 1,600 hours (Chapman 1974).

Riparian brush rabbits typically remain hidden under protective shrub cover. They seldom venture more than 1 meter (m) from cover. They often remain motionless while searching for signs of danger before moving short distances. When pursued, they leap back into the cover of shrubs instead of heading into open ground (Chapman 1974). They will generally not cross large, open areas, and hence are unable to disperse beyond the dense brush of the riparian forest (Williams 1988).

Riparian brush rabbits have limited ability to climb into bushes and trees. This trait probably has significant survival value, given that the riparian forests that are its preferred habitat are subject to inundation by periodic flooding (Chapman 1974, Williams 1988).

When weather conditions are appropriate, individuals may spend time in the early mornings and afternoons basking in the sun on a log or a dry form (a resting place for a rabbit). Ideal basking sites are a few inches from cover no more than about 18 inches above ground, with a partial, low-overstory canopy (Williams 1988, USFWS 1998).

Reproduction. The breeding season is from approximately January to May. The gestation period for brush rabbits is about 27 days, the usual litter size is three to four, and the females may produce three to four litters during the season. Females average nine to 16 offspring per year, which remain in the nest for about 24 days. Although this is a relatively high reproductive rate, five out of six rabbits do not survive to the next breeding season (Mossman 1955, Chapman and Harman 1972). Their eyes open at ten days but they remain in the nest for another two weeks. The nest is a shallow burrow lined with grasses and fur and covered by a plug of residual vegetation. Young mature at four to five months old (Williams 1988, Larsen 1993, USFWS 1998).

Home Range/Territory Size. Home ranges are small and generally conform to the size of the available brushy habitat (USFWS 1998). Individuals are intolerant of each other when they come too close, but there is no well-defined territoriality. Young are more tolerant of approach by another rabbit than are adults (Chapman 1974, USFWS 1998).

Foraging Behavior and Diet. Riparian brush rabbits feed at the edges of shrub cover rather than in large openings. Their diet consists of herbaceous vegetation, such as grasses, sedges, clover, forbs, and buds, bark, and leaves of woody plants. They consume herbaceous plants

found along trails, firebreaks, or at the edge of brushy areas, and they eat the leaves, bark, and buds of many types of woody shrubs and vines within and at the edges of thickets. Grasses and other herbs are the most important food for brush rabbits, but shrubs such as California wild rose, marsh baccharis (*Baccharis douglasii*), and California blackberry (*Rubus ursinus*) also are eaten. When available, green clover (*Trifolium wormskioldii*) is preferred over all other foods (Orr 1940, Larsen 1993, USFWS 1998, Sandoval et al. 2006).

A.2.5 Threats and Stressors

Restricted Range and Habitat Availability. The primary threat to the survival of the riparian brush rabbit is the limited extent of its existing habitat, extremely low numbers of individual animals, and few extant populations. The small size of its remaining population, the behavior of the species, and the highly limited and fragmented nature of remaining habitat restricts natural dispersal and puts the species at risk from a variety of environmental factors. The existing population size does not meet the minimum population sizes that Thomas (1990) suggests are required to assure the medium- to long-term persistence of birds or mammals (i.e., the geometric mean of population size should be 1,000 for species with normally varying numbers and about 10,000 for species exhibiting a high variability in population size). The species is, therefore, considered at a high risk of imminent extinction from several consequent threats related to population genetics and dynamics and environmental variability (USFWS 1998).

Flooding. Periodic flooding still occurs along all major rivers in the Valley (Kindle 1984). With behavioral restrictions on its freedom of movement (low mobility) and the dearth of habitat suitably protected from frequent floods down-stream of Caswell Memorial State Park, there is little chance that individuals that escape drowning or predation will meet mates or reproduce (USFWS 1998).

Predation. Limited and fragmented habitats and flooding increases the risk and extent of predation on riparian brush rabbits. The increased predation to which they are exposed while taking refuge on cleared levees or in exposed bushes or trees contributes directly to population decline and an elevated risk of extinction. Predators of riparian brush rabbits include red-tailed (*Buteo jamaicensis*), Swainsons (*B. swainsoni*), and red-shouldered hawks (*B. lineatus*), owls, feral cats, gray foxes, coyotes, and dogs (Nolan 1984, USFWS 1998).

Fire. Wildfire also poses a major threat due to long-term fire suppression of Caswell Memorial State Park, and combined with prolonged drought, has caused the buildup of high fuel loads from dead leaves, woody debris, and decadent, flammable shrubs. The dense, brushy habitat to which the rabbits are restricted is thus highly susceptible to catastrophic wildfire that would cause both high mortality and severe destruction of habitat. Recovery of the riparian brush rabbit population from such a devastating event would be improbable (USFWS 1998).

Disease. Like most rabbits, the riparian brush rabbit is subject to a variety of common diseases, including tularemia, plague, myxomatosis, silverwater, encephalitis, listeriosis, Q-fever, and brucellosis. These contagious, and generally fatal, diseases could be transmitted easily to riparian brush rabbits from neighboring populations of desert cottontails. In a widespread, genetically heterogeneous population, such an outbreak would be of minimal concern. However, in this small, remnant brush rabbit population, this kind of epidemic could quickly eliminate the entire population (Williams 1988, USFWS 1998).

A.2.6 Relevant Conservation Efforts

The following from the "Recovery Plan for Upland Species of the San Joaquin Valley, California" (USFWS 1998) describes conservation efforts undertaken through the end of the 1990s.

In 1986, after surveys along rivers within its historical range indicated that there was only a single, small extant population in Caswell Memorial State Park (Williams and Basey 1986), the riparian brush rabbit was designated as a "Mammalian Species of Special Concern" by the DFG Wildlife Management Division. It was given Federal category-1 candidate status by USFWS in 1985 and remained a candidate for listing in USFWS's most recent Notice of Review (61 FR 7596). The riparian brush rabbit was proposed for listing by the USFWS on November 21, 1997 (62 FR 62276). The subspecies was listed as endangered by the State of California in May 1994 (Title 14, Division 1, California Administrative Code, Section 670.5, Animals of California declared to be endangered or threatened).

Besides the passive protection afforded to the species by the status of Caswell as a State Park, the California Department of Parks and Recreation funded a study of ecology and habitat management of riparian brush rabbits (Basey 1990, Williams 1988) and a small mammal inventory (Cook 1992). California Department of Parks and Recreation, Bureau of Reclamation, and USFWS, through the Endangered Species Recovery Program, funded a population assessment in the winter of 1993 and 1996-1997 (Williams 1993). The California Department of Parks and Recreation has expanded fire trails in Caswell Memorial State Park, which provides additional edge habitat for rabbits and better access to fight fires. The agency also has an on-going control program for feral animals, has curtailed ground-squirrel control (brush rabbits will eat treated bait meant for ground squirrels), and is involved in ongoing planning for habitat protection for wildlife in the park.

The Bureau of Reclamation implemented a program to establish an experimental population on the Kings River in Fresno County, outside of the historical range of the subspecies. This effort was initiated when the Endangered Species Recovery Program suggested to the Bureau of Reclamation that establishing a population of riparian brush rabbits on public property along the Kings River could be one option for partially meeting their mitigation responsibilities under the Friant Biological Opinion. Besides Bureau of Reclamation, potential participants in this cooperative project include Caltrans, Endangered Species Recovery Program, Fresno County, U.S. Army Corps of Engineers, and DFG.

In 1999, the Endangered Species Recovery Program at California State University Stanislaus began implementing a Controlled Propagation and Reintroduction Plan for the Riparian Brush Rabbit (Williams et al. 2002a), which was recommended in the Recovery plan for upland species of the San Joaquin Valley, California (USFWS 1998). The primary goal of the program was to prevent extinction by providing animals for reintroduction to establish new populations, or augmentation of existing populations. This effort is ongoing.

In response to development activities in the City of Lathrop, mitigation lands have been acquired along the San Joaquin River and Paradise Cut for purposes of preserving and restoring habitat for the riparian brush rabbit. The San Joaquin River Oxbow preserve is a 30-acre riparian forest established in 2004 as mitigation for the Union Pacific Homes development in Lathrop and currently under ownership and management of the Center for Natural Lands Management. The preserve was established primarily to protect the riparian brush rabbit. The River Islands project

also intends to implement a plan to manage and restore riparian and other wetland habitats in the Paradise Cut in part to enhance habitat for the riparian brush rabbit.

A.2.7 Species Habitat Suitability Model

The distribution of brush rabbit within the Planning Area will be determined through field surveys to confirm the extent of occupied habitat for impact assessment. Consequently, habitat suitability models will not be used for this purpose.

A.2.8 Recovery Goals

The following recovery actions for the riparian brush rabbit were outlined in the "Recovery plan for upland species of the San Joaquin Valley, California" (USFWS 1998).

Because of the small size of remaining blocks of potential habitat, and the severely limited dispersal capability of the riparian brush rabbit, it is likely to require continuing special protection of its habitat and population. Realization of this limitation should remove barriers to the rapid establishment of as many populations in remnant habitat as possible, and sustaining those populations by reintroduction should any one become extinct. In furtherance of these objectives, the needed actions are:

1. Establish an emergency plan and monitoring system to provide swift action to save individuals and habitat at Caswell Memorial State Park in the event of flooding, wildfire, or a disease epidemic.
2. Develop and implement a cooperative riparian brush rabbit conservation program that will include, at a minimum:
    a) Identifying and obtaining biological information needed in management decisions; researching captive breeding methodology using surrogate species; conducting genetic composition analysis on the riparian brush rabbit population prior to any captive breeding or introduction/reintroduction (the objective is to ensure the establishment of new populations neither depletes the genetic diversity of the source population nor unduly restricts diversity in the newly established population); and implementing the captive breeding program.
    b) A riparian brush rabbit management plan for Caswell Memorial State Park that will incorporate elements detailed by Williams (1988) relating to predator and pest control; fire lines and access roads; campground, picnic, and recreation areas; brush and fuel control; mosquito abatement; habitat enhancement; and expansion of the Park.
    c) Establishment of at least three additional wild populations in the San Joaquin Valley, in restored and expanded suitable habitat within the rabbit's historical range.
    d) A monitoring program of all riparian brush rabbit populations to assess population trends and status.
    e) A long-term reintroduction preplan for the prompt re-establishment of eliminated populations.
    f) A cooperative program, to take effect once the minimum of four protected populations are established, to place excess young (or other animals as appropriate) from populations at carrying capacity onto private parcels with suitable habitat where owners are willing to enter into a management agreement.

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